



झारखण्ड गजट

असाधारण अंक

झारखण्ड सरकार द्वारा प्रकाशित

20 माघ, 1944 (श०)

संख्या – 76 राँची, गुरुवार,

9 फरवरी, 2023 (ई०)

खान एवं भूतत्व विभाग

अधिसूचना

18 जनवरी, 2023

संख्या-01/भू0स्था0(नियमावली)-05-05/2016- 124-- भारतीय संविधान के अनुच्छेद 309 के परंतुक द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए झारखण्ड के राज्यपाल एतद् द्वारा झारखण्ड राज्य के खान एवं भूतत्व विभाग के अधीन अधिसूचित झारखण्ड भूतात्विक सेवा नियमावली 2011 में संशोधन करते हुये निम्नलिखित नियमावली बनाते हैं :-

1. संक्षिप्त शीर्षक विस्तार एवं प्रारंभ:-

- (I) यह नियमावली 'झारखण्ड भूतात्विक सेवा (संशोधन) नियमावली, 2022" कहलायेगी।
- (II) इसका विस्तार सम्पूर्ण झारखण्ड राज्य में होगा।

(III) यह संशोधन अधिसूचना गजट का प्रकाशन की तिथि से प्रभावी होगी।

2. झारखण्ड भूतात्विक सेवा नियमावली, 2011 (जिसे इस नियमावली के सभी उद्देश्यों के लिये मूल नियमावली पढ़ा जाये एवं समझा जाय।) के नियम 2 के परिभाषा उपखण्ड (iii) में अंकित "नियम 7" को "पार्ट IV एवं V" से प्रतिस्थापित किया जाता है।

मूल नियमावली के नियम 2 के उपखण्ड (xi) के पश्चात् उपखण्ड (xii) "नियुक्ति प्राधिकार" एवं (xiii) "झारखण्ड भूतात्विक सेवा" की परिभाषा निम्नरूपेण जोड़ा जाता है :-

(xii) "नियुक्ति प्राधिकार" से अभिप्रेत है "झारखण्ड सरकार, खान एवं भूतत्व विभाग"।

(xiii) "झारखण्ड भूतात्विक सेवा" से तात्पर्य एक "राज्य सेवा" है।

3. मूल नियमावली के भाग-II के नियम 3 (1) से "तीन" को "दो" से प्रतिस्थापित किया जाता है।

भाग- II नियम 3 (1) (ख) वेधन शाखा विलोपित करते हुये नियम 3 (2) को निम्नवत् अन्तःस्थापित किया जाता है:-

3 (2) झारखण्ड भूतात्विक सेवा राज्य सेवा समझी जायेगी।

4. मूल नियमावली के भाग-II नियम 4 से "वेधन शाखा एवं" को विलोपित किया जाता है तथा "तीनों " को "दोनों" से प्रतिस्थापित किया जाता है।

5. मूल नियमावली के भाग-III नियम 5 (I) (ख) को विलोपित किया जाता है एवं नियम 5 (II) के पश्चात् उप नियम (III) एवं (IV) निम्नवत् अन्तःस्थापित किया जाता है:-

(III) रिक्तियों की अधियाचना:-

क) निदेशक, भूतत्व द्वारा प्रत्येक वर्ष की पहली जनवरी की स्थिति के आधार पर रिक्तियों की गणना की जायेगी। उक्त रिक्तियों की सूचना विभाग को दी जायेगी। विभाग द्वारा रिक्तियों का सत्यापन किया जायेगा।

ख) विभाग द्वारा रोस्टर क्लीयरेंस कराकर आरक्षण कोटिवार अधियाचना झारखण्ड लोक सेवा आयोग को प्रत्येक वर्ष के फरवरी माह तक भेज दी जायेगी।

(IV) रिक्तियों में आरक्षण:- राज्य सरकार द्वारा समय-समय पर प्रवृत्त आरक्षण नीति का नियुक्ति एवं प्रोन्नति में दृढ़ता से अनुपालन किया जायेगा।

6. मूल नियमावली के भाग-IV के नियम-7 में निम्न को अन्तःस्थापित किया जाता है:-

उम्र निर्धारण हेतु कट-आफ-डेट अध्यायना वर्ष की पहली अगस्त रहेगी। सीधी भर्ती के लिये न्यूनतम उम्र 21 वर्ष एवं अधिकतम आयु सीमा वही होगी जैसा कि सरकार/कार्मिक, प्रशासनिक सुधार एवं राजभाषा विभाग द्वारा समय-समय पर विहित किया जाय।

7. मूल नियमावली के भाग-IV नियम 8 (ख) को विलोपित किया जाता है।
8. मूल नियमावली के भाग-V के नियम-11 के उप नियम (IV) को विलोपित किया जाता है।
9. मूल नियमावली के भाग-V के नियम-11 के टिप्पणी में "राजपत्रित पदाधिकारी द्वारा अभिप्रमाणित" के स्थान पर "स्वअभिप्रमाणित" प्रतिस्थापित किया जाता है।
10. मूल नियमावली के भाग-V के नियम-12 (I) (ख) को विलोपित किया जाता है एवं 12 (I) (क) (ग) एवं (घ) को निम्नवत् प्रतिस्थापित किया जाता है: -

(क) भूतत्ववेत्ता

क्र0	विषय	परीक्षा का समय	कुल अंक	न्यूनतम अर्हक प्राप्तांक
I	भू-विज्ञान (स्नातकोत्तर स्तर) (भू-विज्ञान परीक्षा का पाठ्यक्रम अनुलग्नक-I के रूप में संलग्न है)	3:00 घंटा	150 अंक 150 अंक Paper (I) Paper (II)	सामान्य वर्ग- 40%, पिछड़ा वर्ग एनेक्चर-I- 34%, पिछड़ा वर्ग एनेक्चर-II- 36.5%, अनुसूचित जाति/ अनुसूचित जनजाति एवं महिला तथा अन्य वर्ग-32%, आदिम जनजाति-30%,आर्थिक रूप से कमजोर वर्ग-40%
II	सामान्य ज्ञान	2:00 घंटा	100 अंक	
III	हिन्दी (10वीं स्तर)	2:00 घंटा	100 अंक	

(ख) विज्ञान पदाधिकारी

क्र0	विषय	परीक्षा का समय	कुल अंक	न्यूनतम प्राप्तांक
I	भू-विज्ञान भू-रसायन (GeoChemistry) स्पेशल पेपर के साथ (स्नातकोत्तर स्तर) (संबंधित परीक्षा का पाठ्यक्रम अनुलग्नक-I के रूप में संलग्न है)	3:00 घंटा	150 अंक 150 अंक Paper (I) Paper (II)	सामान्य वर्ग- 40%, पिछड़ा वर्ग एनेक्चर-I- 34%, पिछड़ा वर्ग एनेक्चर-II- 36.5%, अनुसूचित जाति/ अनुसूचित जनजाति एवं महिला तथा अन्य वर्ग-32%, आदिम जनजाति-30%,आर्थिक रूप से कमजोर वर्ग-40%
II	सामान्य ज्ञान	2:00 घंटा	100 अंक	
III	हिन्दी (10वीं स्तर)	2:00 घंटा	100 अंक	

(ग) रसायनज्ञ

क्र0	विषय	परीक्षा का समय	कुल अंक	न्यूनतम प्राप्तांक
I	रसायन शास्त्र (स्नातकोत्तर स्तर) (रसायन शास्त्र परीक्षा का पाठ्यक्रम अनुलग्नक-II के रूप में संलग्न है)	3:00 घंटा	150 अंक 150 अंक Paper (I) Paper (II)	सामान्य वर्ग- 40%, पिछड़ा वर्ग एनेक्चर-I- 34%, पिछड़ा वर्ग एनेक्चर-II- 36.5%, अनुसूचित जाति/ अनुसूचित जनजाति एवं महिला तथा अन्य वर्ग-32%, आदिम जनजाति-30%,आर्थिक रूप से कमजोर वर्ग-40%
II	सामान्य ज्ञान	2:00 घंटा	100 अंक	
III	हिन्दी (10वीं स्तर)	2:00 घंटा	100 अंक	

11. मूल नियमावली के भाग-V के नियम 22 को निम्नवत् प्रतिस्थापित किया जाता है:-

नियुक्ति हेतु अनुशंसित अभ्यर्थियों को CMO/Civil Surgeon से Medical Report (Fitness Certificate) प्रस्तुत करना होगा।

विज्ञान पदाधिकारी पद के अभ्यर्थियों को Colour Blindness नहीं होने का चिकित्सा पर्षद द्वारा निर्गत प्रमाण पत्र चयन के पश्चात् प्रस्तुत करना अनिवार्य होगा।

12. मूल नियमावली के भाग-VI के नियम-23 के (i) से “भूतत्ववेत्ता, सहायक वेधि अभियन्ता एवं” को विलोपित करते हुये “20%” को “25%” से प्रतिस्थापित किया जाता है:-

भाग-VI के नियम-23 (iv) से “भूतत्ववेत्ता, सहायक वेधि अभियन्ता” को विलोपित किया जाता है।

13. मूल नियमावली के भाग-VII के नियम- 24 को निम्नवत् प्रतिस्थापित किया जाता है:-

सेवा में मूल कोटि में नियुक्त पदाधिकारियों के लिए परीक्ष्यमान अवधि 02 वर्ष रहेगी।

14. मूल नियमावली के भाग-VII के नियम- 25 (i) (ग) में निम्नवत् प्रतिस्थापित किया जाता है:-

सेवा के मूल कोटि में नियुक्त पदाधिकारियों को विभागीय परीक्षा उत्तीर्ण करना अनिवार्य होगा।

15. मूल नियमावली के भाग-VIII के नियम-26 (i) को निम्नवत् प्रतिस्थापित किया जाता है:-

विज्ञान पदाधिकारी एवं रसायनज्ञ के मूल पद के “25%” पद को क्रमशः विज्ञान सहायक एवं भूतात्विक विश्लेषक से प्रोन्नति देकर भरा जायेगा।”

16. मूल नियमावली के भाग-VIII के नियम-26 (i) (ख) को विलोपित किया जाता है।

17. मूल नियमावली के भाग VIII के नियम-26 (ii) से उप निदेशक वेधन को विलोपित किया जाता है एवं कार्मिक, प्रशासनिक सुधार तथा राजभाषा विभाग, झारखण्ड सरकार के संकल्प संख्या 15/नीति नि0-07-02/2014 का0-1385/राँची, दिनांक 13.02.2014 की कंडिका-5 (क) (i) के आलोक में निम्नवत् प्रतिस्थापित किया जाता है:-

“सहायक निदेशक, भूतत्व-सह-वरीय भूतत्ववेत्ता, उप निदेशक भूतत्व, अपर निदेशक, भूतत्व, निदेशक, भूतत्व, वरीय विज्ञान पदाधिकारी, उप निदेशक प्रयोगशाला, उप निदेशक, रसायन, वरीय रसायनज्ञ के पद पर प्रोन्नति सरकार द्वारा कार्मिक, प्रशासनिक सुधार एवं राजभाषा विभाग, झारखण्ड द्वारा निर्धारित प्रक्रिया के अनुसार विभागीय प्रोन्नति समिति की अनुशंसा पर विभाग द्वारा दी जायेगी।

परन्तु यह भी कि केवल सेवा के वैसे पदाधिकारियों को ही मूल कोटि से उच्च कोटि में प्रोन्नत किया जाएगा जिनकी सेवा सम्पुष्ट हो।”

18. मूल नियमावली के भाग -X के नियम-34 को निम्नवत् प्रतिस्थापित किया जाता है:-

कार्मिक, प्रशासनिक सुधार एवं राजभाषा विभाग के पत्रांक 7782, दिनांक 07.09.2016 तदोपरान्त विभागीय जापांक 2481, दिनांक 25.11.2016 एवं समय-समय पर यथा निर्गत दिशा-निर्देशों के आलोक में इस सेवा पदाधिकारियों के वार्षिक अभ्युक्ति का लेखन होगा।

19. मूल नियमावली के भाग-X के नियम-36 से सहायक वेधि अभियंता को विलोपित किया जाता है।

20. मूल नियमावली के भाग-X के नियम-38 के अनुसूची (क) को निम्नवत् प्रतिस्थापित किया जाता है:-

अनुसूची - क (नियम-38)

विभागीय परीक्षा हेतु पाठ्यक्रम

क्र	विषय	लिखित/ मौखिक	परीक्षा का समय	कुल अंक	न्यूनतम प्राप्तांक
I	भाषा हिन्दी - (राजस्व पर्षद, झारखण्ड सरकार द्वारा विहित पाठ्यक्रम के अनुसार)	लिखित	2:00 घंटा	100 अंक	उत्तीर्णता के लिए राजस्व पर्षद झारखण्ड सरकार के द्वारा निर्धारित मानदण्ड के अनुरूप न्यूनतम प्रतिशत अंक मान्य होगा।
		मौखिक	-	100 अंक	
II	भाषा जनजातीय भाषा - (राजस्व पर्षद, झारखण्ड सरकार द्वारा विहित पाठ्यक्रम के अनुसार)	लिखित	1:00 घंटा	100 अंक	उत्तीर्णता के लिए राजस्व पर्षद झारखण्ड सरकार के द्वारा निर्धारित मानदण्ड के अनुरूप न्यूनतम प्रतिशत अंक मान्य होगा।
		मौखिक	-	100 अंक	
III	लेखा-भाग-I - कोषागार नियमावली, वित्त नियमावली, सचिवालय अनुदेश, भविष्य निधि नियमावली। (पुस्तक सहित)	लिखित	2:00 घंटा	100 अंक	उत्तीर्णता के लिए राजस्व पर्षद झारखण्ड सरकार के द्वारा निर्धारित मानदण्ड के अनुरूप न्यूनतम प्रतिशत अंक मान्य होगा।
IV	लेखा-भाग-II - सेवा संहिता, पेंशन नियमावली, यात्रा भत्ता नियमावली, सरकारी सेवा आचार नियमावली। (पुस्तक रहित)	लिखित	2:00 घंटा	100 अंक	
V	अधिनियम एवं नियम - द माईन्स एण्ड मिनरल्स (डेवलपमेंट एण्ड रेगुलेशन) एक्ट 1957 एवं इसके	लिखित	2:00 घंटा	100 अंक	उत्तीर्णता के लिए न्यूनतम अहर्त्तांक अनारक्षित 50%, अनुसूचित जाति/ अनुसूचित जनजाति 40%, महिला सभी कोटि 40%

अन्तर्गत प्रख्यापित विनियमन, मिनरल कनशेसन रूल्स 1960/2016, झारखण्ड माइनर मिनरल कनशेसन रूल्स 2004 एवं समय-समय पर यथा संशोधित, मिनरल कनशेसन डेवलपमेंट रूल्स 1988, झारखण्ड माइनर मिनरल (एम्बिडेन्स आफ मिनरल कन्टेन्स) रूल्स 2017, फारेस्ट कन्जरवेशन एक्ट। (पुस्तक सहित)				
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21. मूल नियमावली के नियम 39 के बाद नियम 39 (क) को निम्नवत् अन्तः स्थापित किया जाता है:-

"इस सेवा के पदाधिकारी को खान एवं भूतत्व विभाग अन्तर्गत किसी भी संवर्ग में कार्यहित में प्रतिनियुक्त किया जा सकेगा"

22. मूल नियमावली के भाग-XII के नियम-42 (iii) को विलोपित किया जाता है।

झारखण्ड राज्यपाल के आदेश
से,

(अबुबक्कर सिद्दीख पी0)
सरकार के सचिव

Department of Mines and Geology

NOTIFICATION

18th January, 2023

No. 01/Bhu.Stha.(Niyamawali)-05-05/2016-124-- In exercise of the powers conferred by the provision to Article 309 of Constitution of India, the Governor of Jharkhand is pleased to make following rules to amend the "The Jharkhand Geological Service Rules 2011."

1. **SHORT TITLE AND COMMENCEMENT:**

(i) These Rules shall be called **"Jharkhand Geological Service (Amendment) Rules, 2022.**

(ii) It shall extend to the whole State of Jharkhand.

(iii) These rules shall come into force from the date of publication of this notification in the official gazette of the State.

2. In para (iii) of rule 2 of the Jharkhand Geological Service Rules, 2011 (Hereinafter referred to as the principal rule) "rule 7" is replaced by Part IV and V.

Para (xii) and para (xiii) is inserted after para (xi) of Rule 2 in the Principal rule to define "Appointing Authority" and "Jharkhand Geological Service" as below-

(xii) "Appointing Authority" means "Department of Mines & Geology, Government of Jharkhand".

(xiii) "Jharkhand Geological Service" means a "State Service".

3. In principal Rule 3 (I) of Part-II the "three" is replaced by "two".

In principal Rule 3 (I) (b) of Part-II the "Drilling Wing" is omitted and Rule 3(2) is inserted as below: -

"3 (2)- Jharkhand Geological Service would be a State Service."

4. In principal Rule 4 of Part II "Both the Drilling wing and" is omitted and 'three' is replaced by 'two'.

5. In principal Rule 5 (I) (b) is omitted and rule (III) and (IV) is inserted after rule 5 (II) as under: -

(III) Requisition of Vacancies: -

(a) The number of vacancies shall be calculated by the Director, Geology on 1st January of every year. Vacancies thus calculated shall be intimated to the Department of Mines and Geology which shall authenticate the same.

- (b) Department shall get the Roster clearance done and requisition with category wise reservation shall be sent to the Jharkhand State Public Service Commission by the month of February each year.

(IV) Reservation in Vacancies: - The reservation policy as prescribed by the State from time to time shall be strictly complied with in the matters of appointment as well as promotion.

6. In Rule 7 of Part- IV of the principal rule following clause is inserted: -

The cut-off date for the age determination shall be 1st August of the year of requisition. The minimum age for direct recruitment is twenty-one years and the maximum age limit will be as per provisions of the Department of Personnel Administrative Reforms and Rajbhasha.

7. In principal Rule 8 (b) of Part-IV is omitted.
8. In principal Rule 11 (iv) of Part V is omitted.
9. In the statement of Note of Rule 11 of Part V of principal rule “attested by a Gazette Officer” is replaced by “self-attested”.
10. From Part V of principal Rule, 12 (b) is omitted and 12 (a) (c) (d) is substituted as:

(a) Geologist

Sl. No.	Subject	Exam Time	Full Marks	Minimum Qualifying Marks
I	Geology (M.Sc. level) (The Syllabus of examination is enclosed as annexure-I)	3:00 hrs	150 150 Paper (I) Paper (II)	General-40%, Backward Class Annexure – I - 34%, Backward Class Annexure - II- 36.5%, ST/SC/ Woman- 32%, Primitive Tribe- 30%, EWS-40%.
II	General Knowledge	2:00 hrs	100	
III	Hindi (10 th Level)	2:00 hrs	100	

(b) Scientific Officer

Sl. No.	Subject	Exam Time	Full Marks	Minimum Qualifying Marks
I	Geology with Geo-chemistry as special paper (Master Degree Level) (The Syllabus examination is enclosed as annexure-I)	3:00 hrs	150 150 Paper (I) Paper (II)	General-40%, Backward Class Annexure – I - 34%, Backward Class Annexure - II- 36.5%, ST/SC/ Woman- 32%, Primitive Tribe- 30%, EWS-40%.
II	General Knowledge	2:00 hrs.	100	
III	Hindi (10 th Level)	2:00 hrs.	100	

(c) Chemist

Sl. No.	Subject	Exam Time	Full Marks	Minimum Qualifying Marks
I	Chemistry (Master Degree Level) (The Syllabus examination is enclosed as annexure-II)	3:00hrs.	150 150 Paper (I) Paper (II)	General-40%, Backward Class Annexure – I - 34%, Backward Class Annexure - II- 36.5%, ST/SC/ Woman- 32%, Primitive Tribe- 30%, EWS-40%.
II	General Knowledge	2:00 hrs.	100	
III	Hindi (10 th Level)	2:00 hrs.	100	

11. In principal Rule 22 of Part-V is substituted as under-

Candidates recommended for appointment shall have to produce a medical report (Fitness Certificate) issued by CMO/Civil Surgeon. It is mandatory for candidates recommended for the post of Scientific Officer to produce a 'no color blindness' certificate issued by the medical board.

12. In principal Rule 23 (i) of Part-VI the words "Geologist, Assistant Drilling Engineer and" are omitted and "20 %" is replaced by '25%'.

The words "Geologist, Assistant Drilling Engineer and" are omitted from the Rule 23(iv) of Part VI of the Principal Rule.

13. In principal Rule 24 of Part-VII is substituted as under-

Officers recruited/appointed in basic grade in the service shall be on probation for a period of two (02) years.

14. In principal Rule 25 (i) (c) of Part-VII substituted in the following manner is: -

Officers recruited /appointed in the service must pass departmental examination.

15. In principal Rule 26 (i) of Part-VIII substituted as under-

25% of basic posts of Scientific Officer & Chemist of Laboratory Cadre shall be filled up by promotion respectively from the post of Scientific Assistant and Geological Analyst.

16. In principal Rule 26 (i) (b) of Part-VIII is omitted.**17. From Rule 26 (ii) of Part-VIII**

Deputy Director, Drilling is omitted and as per Para-5 (a) (i) of Resolution of Department of Personnel, Administrative Reform & Rajbhasha, Government of Jharkhand bearing no. 15/Niti.Ni-07-02/2014 Ka-1385/Ranchi Dated-13.02.2014 Rule 26(ii) of part VIII is substituted as under:

Promotion to the post of Asstt. Director-cum-Senior Geologist, Deputy Director Geology, Additional Director Geology, Director, Geology, Deputy Director Drilling Senior Scientific Officer, Deputy Director Lab, Senior Chemist & Deputy Director Chemical shall be given as per procedure laid down by Department of Personnel Administrative Reforms & Rajbhasha, Government of Promotion Committee by the Department.

Provided further that only those officers of Service shall be promoted from basis grade to the higher grade whose Service have been confirmed.

18. In principal Rule 34 of Part-IX is substituted as under-

Annual Confidential Report of Officers of this service shall be written as per guidelines vide Letter no 7782, Dated 07.09.2016 of Personnel, Administrative Reforms & Rajbhasha and Departmental Memo no-2481, dated 25.11.2016 and as issued from time to time.

19. From Principal Rule 36 of X

Assistant Drilling Engineer is omitted.

20. Schedule-A of Rule 38 Part-X is substituted as under-

Schedule-A (Rule: -38)
Syllabus for Departmental
Examination

Sl No	Subject	Written / Oral	Exam Time	Total Marks	Minimum marks
I	Hindi Language (Syllabus as laid down by the Board of Revenue, Jharkhand)	Written	2:00 hrs.	100	Pass marks will be acceptable as per norms fixed by Board of Revenue, Govt. of Jharkhand
		Oral	--	100	
II	Language- Tribal language- (Syllabus as laid down by the Board of Revenue, Jharkhand)	Written	2:00 hrs.	100	Pass marks will be acceptable as per norms fixed by Board of Revenue, Govt. of Jharkhand
		Oral	--	100	
III	Accounts Paper- I Treasury Rules, Financial Rules Secretariat Regulation, Provident Fund Rules (With Book)	Written	2:00 hrs.	100	Pass marks will be acceptable as per norms fixed by Board of Revenue, Govt. of Jharkhand
IV	Accounts Paper- II services Code, Pension Rules, T.A Rules, Code of Conduct of Govt. Servant (Without Book)	Written	2:00 hrs.	100	
V	Acts & Rules the Mines & Mineral (Development & Regulation) Act. 1957 and Regulation Made there under Mineral Concession Rules 1960/2016 Jharkhand Minor Mineral Concession Rules 2004 and as amended time to time, Mineral concession Development Rules, 1988 Jharkhand Minor Mineral (Evidence of Mineral Contents) Rules 2017, Forest Conservation Act. (With Book)	Written	2:00 hrs.	100	Minimum qualifying marks for Unreserved 50%, SC/ST 40%, Woman all category 40%.

21. After Rule 39, (a) is inserted as under: –

Officer of this service can be deputed in any cadre of the Mines & Geology Department in the interest of Work.

22. In principal Rule 42 (iii) of Part-XII is omitted.

By the order of the Governor,

(Aboobacker Siddique P)
Secretary to the Government.

Syllabus for Geologist/ Scientific Officer Exam

Geology Paper I (150 marks)

Section A: Geomorphology and Remote Sensing.

Basic principles. Weathering and soils, Mass wasting. Influence of climate on processes. Concept of erosion cycles. Geomorphology of fluvial tracts, arid zones, coastal regions, 'Karst' landscapes and glaciated ranges. Geomorphic mapping, slope analysis and drainage basin analysis. Applications of geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies. Topographical maps. Geomorphology of India.

Concepts and principles of aerial photography and photogrammetry, satellite remote sensing — data products and their interpretation. Digital image processing. Remote sensing in landform and land use mapping, structural mapping, hydrogeological studies and mineral exploration. Global and Indian Space Missions. Geographic information System (GIS) — principles and applications.

Section B: Structural Geology

Principles of geological mapping and map reading, projection diagrams. Stress-strain relationships of elastic, plastic and viscous materials. Measurement of strain in deformed rocks. Behaviour of minerals and rocks under deformation conditions. Structural analysis of folds, cleavages, lineations, joints and faults. Superposed deformation. Mechanism of folding and faulting. Time-relationship between crystallization and deformation. Unconformities and basement-cover relations. structural behaviour of igneous rocks, diapirs and salt domes. Introduction to petrofabrics.

Section C: Geotectonics

Earth and the solar system, Meteorites and other extra-terrestrial materials, Planetary evolution of the earth and its internal structure. Heterogeneity of the earth's crust. Major tectonic features of the Oceanic and Continental crust. Continental drift—geological and geophysical evidence, mechanics, objections, present status. Gravity and magnetic anomalies at Mid-ocean ridges, deep sea trenches,

continental shield areas and mountain chains. Palaeomagnetism. Seafloor spreading and Plate Tectonics. Island arcs, Oceanic islands and volcanic arcs. Isostasy, orogeny and epeirogeny. Seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate.

Section D: Stratigraphy

Nomenclature and the modern stratigraphic code.

Radioisotopes and measuring geological time. Geological time-scale. Stratigraphic procedures of correlation of unfossiliferous rocks. Precambrian stratigraphy of India. Stratigraphy of the Palaeozoic, Mesozoic and Cenozoic formations of India.

Gondwana system and Gondwanaland. Rise of the Himalaya and evolution of Siwalik basin. Deccan Volcanics. Quaternary Stratigraphy. Rock record, palaeoclimates and palaeogeography.

Section E: Palaeontology

Fossil record and geological time-scale. Morphology and time-ranges of fossil groups. Evolutionary changes in molluscs and mammals in geological time. Principles of evolution. Use of species and genera of foraminifera and echinodermata in biostratigraphic correlation. Siwalik vertebrate fauna and Gondwana flora, evidence of life in Precambrian times, different microfossil groups and their distribution in India.

Geology Paper II (150 Marks)

Section A: Mineralogy

Physical, chemical and crystallographic characteristics of common rock forming silicate mineral groups. Structural classification of silicates. Common minerals of igneous and metamorphic rocks. Minerals of the carbonate, phosphate, sulphide and halide groups.

Optical properties of common rock forming silicate minerals, uniaxial and biaxial minerals. Extinction angles, pleochroism, birefringence of minerals and their relation with mineral composition. Twinned crystals. Dispersion. The U-stage.

Section B: Igneous and Metamorphic Petrology

Forms, textures and structures of igneous rocks. Silicate melt equilibria, binary and ternary phase diagrams. Petrology and geotectonic evolution of granites, basalts, andesites and alkaline rocks. Petrology of gabbros, kimberlites, anorthosites and carbonatites. Origin of primary basic magmas.

Textures and structures of metamorphic rocks. Regional and contact metamorphism of pelitic and impure calcareous rocks. Mineral assemblages and

P/T conditions. Experimental and thermodynamic appraisal of metamorphic reactions. Characteristics of different grades and facies of metamorphism. Metasomatism and granitization, migmatites. Plate tectonics and metamorphic zones. Paired metamorphic belts.

Section C: Sedimentology

Matrix and cement of terrigenous sediments. Definition, measurement and interpretation of grain size. Elements of hydraulics. Primary structures, palaeocurrent analysis. Biogenic and chemical sedimentary structures. Sedimentary environment and facies. Facies modelling for marine, non-marine and mixed sediments. Tectonics and sedimentation. Classification and definition of sedimentary basins, Sedimentary basins of India. Cyclic sediments. Seismic and sequence stratigraphy. Purpose and scope of basin analysis. Structure contours and isopach maps.

Section D: Geochemistry

Earth in relation to the solar system and universe, cosmic abundance of elements. Composition of the planets and meteorites. Structure and composition of earth and distribution of

elements. Trace elements. Elementary crystal chemistry and thermodynamics. Introduction to isotope geochemistry. Geochemistry of hydrosphere, biosphere and atmosphere. Geochemical cycle and principles of geochemical prospecting.

Section E: Environmental Geology

Concepts and principles. Natural hazards — preventive/ precautionary measures

—floods, landslides, earthquakes, river and coastal erosion. Impact assessment of anthropogenic activities such as urbanization, open cast mining and quarrying, river-valley projects, disposal of industrial and radio-active waste, excess withdrawal of ground water, use of fertilizers, dumping of ores, mine waste and fly-ash. Organic and inorganic contamination of ground water and their remedial measures. Soil degradation and remedial measures. Environment protection — legislative measures in India.

Section F: Indian mineral deposits and mineral economics

Occurrence and distribution in India of metalliferous deposits — base metals, iron, manganese, aluminium, chromium, nickel, gold, silver, molybdenum. Indian deposits of non-metals — mica, asbestos, barytes, gypsum, graphite, apatite and beryl. Gemstones, refractory minerals, abrasives and minerals used in glass, fertilizer, paint, ceramic and cement industries. Building stones. Phosphorite deposits. Placer deposits, rare earth minerals.

Strategic, critical and essential minerals. India's status in mineral production. Changing patterns of mineral consumption. National Mineral Policy. Mineral Concession Rules. Marine mineral resources and Law of Sea.

Section G: Ore genesis

Ore deposits and ore minerals. Magmatic processes of mineralisation. Porphyry, skarn and hydrothermal mineralisation. Fluid inclusion studies. Mineralisation associated with—(i)ultramafic,mafic and acidic rocks,(ii)greenstone belts,(iii) komatiites,anorthosites and kimberlites and(iv)submarinevolcanism.Magma-related mineralisation through geological time.Stratiform and stratabound ores. Ores and metamorphism — cause and effect relations.

Section H: Mineral exploration

Methods of surface and subsurface exploration, prospecting for economic minerals — drilling, sampling and assaying. Geophysical techniques — gravity, electrical, magnetic, airborne and seismic. Geomorphological and remote sensing techniques. Geobotanical and geochemical methods. Borehole logging and surveys for deviation.

Section I: Geology of fuels

Definition, origin of coal. Stratigraphy of coal measures. Fundamentals of coal petrology, peat, lignite, bituminous and anthracite coal. Microscopic constituents of coal. Industrial application of coal petrology. Indian coal deposits. Diagenesis of organic materials.

Origin, migration and entrapment of natural hydrocarbons. Characters of source and reservoir rocks. Structural, stratigraphic and mixed traps. Techniques of exploration. Geographical and geological distributions of onshore and offshore petroliferous basins of India.

Mineralogy and geochemistry of radioactive minerals. Instrumental techniques of detection and measurement of radioactivity. Radioactive methods for prospecting and assaying of mineral deposits. Distribution of radioactive minerals in India. Radioactive methods in petroleum exploration — well logging techniques. Nuclear waste disposal — geological constraints.

Section J: Engineering geology

Mechanical properties of rocks and soils. Geological investigations for river valley projects — Dams and reservoirs; tunnels — types, methods and problems. Bridges types and foundation problems. Shoreline engineering. Landslides — classification, causes, prevention and rehabilitation. Concrete aggregates — sources, alkali-aggregate reaction. Aseismic designing — seismicity in India and earthquake-resistant structures. Problems of ground water in engineering projects. Geotechnical case studies of major projects in India.

Syllabus for Chemist Officer Exam

PAPER-I (inorganic Chemistry) (150 Marks)

Atomic structure:

Electromagnetic spectrum, black body radiation and Planck's hypothesis, photoelectric effect, Borh's quantum theory of hydrogen atom. Dual character of electron, de-Broglies relationship, Davisson and German experiment. Heisenbergs Uncertainty Principle. Time independent Schrodingers equation for hydrogen like atom-Physical significance of the terms involved in the equation. Significance of Ψ and conditions for its acceptability. Normalization and orthogonality of wave function and angular wave function, their significance, quantum numbers, shapes of orbitals and their labeling, aufbau principle, Paulies exclusion principle, Hund's rule, electronic configuration of atoms and monoatomic ions.

Chemical periodicity:

Classification of elements on the basis of electronic configuration. Modern IUPAC Periodic table. General characteristic of s, p, d and f block elements. Effective nuclear charges, screening effects, atomic radii, ionic radii, covalent radii. Ionization potential, electron affinity and electro-negativity. Group trends and periodic trends in these properties in respect of s-, p- and d-block elements. General trends of variation of electronic configuration, elemental forms, metallic nature, magnetic properties, catenation and catalytic properties, oxidation states, aqueous and redox chemistry in common oxidation states, properties and reactions of important compounds such hydrides, halides, oxides, oxy-acids, complex chemistry in respect of s-block and p-block elements.

Chemical Bonding and structure:

Ionic bonding: Size effects, radius ratio rules and their limitations. Packing of ions in crystals, lattice energy, Born- lande equation and its applications, Born-Haber cycle and its applications. Solvation energy, polarizing power and polarizability, ionic potential, Fazan's rules. Defects in solids. Covalent bonding: Lewis structures, formal charge. Valence Bond Theory, Molecular orbital Theory, hybridizations, VSEPR theory. Partial ionic Character of covalent bonds, bond moment, dipole moment and electro negativity differences. Concept of resonance, resonance

energy, resonance structures. Coordinate bonding: Werner theory of coordination compounds, double salts and complex salts, Lewis acid-base. Ambidentate and polydentate ligands, chelate complexes. IUPAC nomenclature of coordination compounds. Coordination numbers, Geometrical isomerism.

Acid-Base reactions

Acid-Base concept: Arrhenius concept, theory of solvent system, Bronsted-Lowry's concept, relative strength of acids, Pauling rules. Lewis concept. Acid-base equilibria in aqueous solution and pH. Acid-base neutralisation curves; indicator, choice of indicators.

Precipitation and Redox Reactions:

Solubility product principle, common ion effect. Ion effect-electron method of balancing equation of redox reaction. Standard redox potentials, Nernst equation. Influence on complexformation, precipitation and change of pH on redox potentials; formal potential. Feasibility of a redox titration, redox potential at the equivalence point, redox indicators. Redoxpotential diagram of common elements and their applications. Disproportionation and comproportionation reactions.

Nuclear chemistry:

Radioactive decay - General characteristics, decay kinetics, parent -daughter decaygrowth relationships, determination of half-lives, Nuclear models -shell model, liquid drop model, Fermi gas model, Collective model and optical model. Nuclear stability. Decay theories. Nuclear reactions- fission, fusion and spallation reactions. Definition of curie and related calculations, preparation of artificial radionuclides by bombardment, radiochemical separation techniques.

s-Block Elements:

Hydride, hydration energies, solvation and complexation tendencies of alkali and alkaline-earth metals, principle of metallurgical extraction, Chemistry of Li and Be, their anomalous behaviour and diagonal, relationships, alkyls and aryls.

p-Block Elements:

Comparative study of group 13 & 14 elements with respect to periodic properties. Compounds such as hydrides, halides, oxides and oxyacids; diagonal relationship; preparation, properties, bonding and structure of diborane, borazine and alkali metal borohydrides. Preparation, properties

and technical applications of carbides and fluorocarbons. Silicones and structural principles of silicates.

Chemistry of d- and f- block elements:

General comparison of 3d, 4d and 5d elements in term of electronic configuration, elemental forms, metallic nature, atomization energy, oxidation states, redox properties, coordination chemistry, spectral and magnetic properties. f-block elements: electronic configuration, ionization energies, oxidation states, variation in atomic and ionic (3+) radii, magnetic and spectral properties of lanthanides, comparison between lanthanide and actinides, separation of lanthanides (by ion-exchange method). Chemistry of some representative compounds: $K_2Cr_2O_7$, $KMnO_4$, $K_2[Fe(CN)_6]$, $K_2(Ni(CN)_4)$, H_2PtCl_6 , $Na_2[Fe(CN)_5NO]$.

PAPER-II (PHYSICAL AND ANALYTICAL CHEMISTRY) (150 MARKS)**Kinetic theory and the gaseous state:**

Gaseous state: Gas laws, kinetic theory of gas, collision and gas pressure, derivation of gas laws from kinetic theory, average kinetic energy of translation, Boltzmann constant and absolute scale of temperature. Maxwell's distribution of speeds. Kinetic energy distribution, calculations of average, root mean square and most probable velocities. Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases.

Collision of gas molecules, Real gases:

Collision diameter; collision number and mean free path; frequency of binary collisions; wall collision and rate of effusion. Real gases, Deviation of gases from ideal behaviour; compressibility factor; Andrew's and Amagot's plots; van der Waals equation and its characteristic features. Existence of critical state. Critical constants in terms of van der Waals constants. Law of corresponding state and significance of second virial coefficient. Boyle temperature. Intermolecular forces.

Liquid state: physical properties of liquids and their measurements: surface tension and viscosity

Solids: Nature of solid state, law of constancy of angles, concept of unit cell, different crystal system, Bravais lattices, law of rational indices, Miller indices, symmetry elements in crystals. X-ray diffraction, Bragg's law, Laue's method, powder method, radius ratio and packing in crystals.

Thermodynamics:

Definition of thermodynamic terms. Thermodynamic functions and their differentials. Zeroth law, First law and Second law of thermodynamics. Cyclic, reversible and irreversible processes. Internal energy (U) and enthalpy (H); relation between C_p and C_v , calculation of w , q , ΔU and ΔH for expansion of ideal gas under isothermal and adiabatic conditions for reversible and irreversible processes including free expansion. Joule-Thomson Coefficient and inversion temperature. Application of First law of thermodynamics.

Application of Second law of thermodynamics.

Carnot cycle and its efficiency, Gibbs function (G) and Helmholtz function (A), Gibbs-Helmholtz equation, criteria for thermodynamic equilibrium and spontaneity of a process. Chemical equilibrium: chemical equilibria of homogeneous and heterogeneous systems, derivation of expression of equilibrium constants, Le Chatelier's principle of dynamic equilibrium.

Thermodynamics and Equilibrium:

Chemical potential in terms of Gibbs free energy and other thermodynamic state functions and its variation with temperature and pressure. Gibbs-Duhem equation; fugacity of gases and fugacity coefficient. Thermodynamic conditions for equilibrium, degree of advancement. Van't Hoff's reaction isotherm. Equilibrium constant and standard Gibbs free energy change. Definitions of K_p , K_c and K_x ; van't Hoff's reaction isobar and isochore. Le Chatelier's principle. Activity and activity coefficients of electrolyte ion in solution. Debye-Huckel limiting law.

Acids-bases and solvents:

Modern aspects of acids and bases: Arrhenius theory, theory of solvent system, Bronsted and Lowry's concept, Lewis concept with typical examples, applications and limitations. Strengths of acids and bases. Ionization of weak acids and bases in aqueous solutions, application of Ostwald's dilution law, ionization constants, ionic product of water, pH-scale, buffer solutions and their pH values, buffer actions & buffer capacity: hydrolysis of salts.

Solutions of non-electrolytes: Colligative properties of solution, Raoult's Law, relative lowering of vapor pressure, osmosis and osmotic pressure; elevation of boiling point and depression of freezing point of solvents.

Chemical kinetics and catalysts:

Order and molecularity of reactions, rate laws and rate equations for first order and second order reactions; zero order reactions. Parallel and consecutive reactions. Determination of order of reactions. Temperature dependence of reaction rate, energy of activation. Enthalpy of activation, entropy of activation, effect of dielectric constant and ionic strength of reaction rate, kinetic isotope effect; collision theory & transition State Theory of reaction rate, Catalytic reactions.

Electrochemistry:

Conductance: cell constant, specific conductance and molar conductance. Kohlrausch's law of independent migration of ions, ion conductance and ionic mobility. Equivalent and molar conductance at infinite dilution. Ostwald's dilution law. Debye-Huckel theory. Application of conductance measurement Conductometric titrations. Determination of transport number by moving boundary method. Types of electro chemical cells, cell reactions, emf and change in free energy, ΔH and ΔS of cell reactions. Nernst equation. Standard cells. Half-cells/electrodes, different types of electrodes. Standard electrode potential

and principles of its determination. Types of concentration cells. Liquid junction potential. Glass electrode and determination of pH of a solution. Potentiometric titrations: acid-base and redox, electro chemical power sources; primary, secondary and fuel Cells, corrosion and inhibition of corrosion.

Photochemistry :

Frank-Condon principle and vibrational structure of electronic spectra. Bond dissociation and principle of determination of dissociation energy. Decay of excited states by radiative and non-radiative paths. Fluorescence and phosphorescence, Jablonsky diagram. Laws of photochemistry: Grotthus-Draper law, Stark-Einstein law of photochemical equivalence and Lambert-Beer's law; quantum yield and its measurement for a photochemical process, actinometry. Photostationary state. Photosensitized reactions. Kinetics of HI decomposition, H_2-Br_2 reaction, dimerisation of anthracene.

Basic principles and application of spectroscopy:

Electromagnetic radiation, interaction with atoms and molecules and quantization of different forms of energies. Condition of resonance and energy of absorption for various types of spectra; origin of atomic spectra, spectra of hydrogen atoms, many electron atoms, spin and angular momentum. Rotational spectroscopy of diatomic molecules: rigid rotor model, selection rules, spectrum, characteristic features of spectral lines. Determination of bond length, effect of isotopic

substitution. Vibrational spectroscopy of diatomic molecules: Simple Harmonic Oscillator model, selection rules, Raman Effect. Characteristic features and conditions of Raman activity with suitable illustrations. Rotational and vibrational Raman spectra.

UV Spectra: Electronic transition ($\sigma \rightarrow \sigma^*$, $n \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$), relative positions of λ_{max} considering conjugative effect, steric effect, solvent effect, red shift (bathochromic shift), blue shift (hypsochromic shift), hyperchromic effect, hypochromic effect (typical examples). IR Spectra: Modes of molecular vibrations, applications of Hooke's law, characteristic stretching frequencies of O-H, N-H, C-H, C-D, C=C, C=N, C=O functions; factors effecting stretching frequencies.

PMR Spectra: Nuclear spin, NMR active nuclei, principle of proton magnetic resonance, equivalent and non-equivalent protons, chemical shift, shielding / deshielding of protons, up-field and down-field shifts. NMR peak area, diamagnetic anisotropy, relative peak positions of different kinds of protons, substituted benzenes.

Theoretical basis of Quantitative inorganic analysis:

Law of mass action, chemical and ionic equilibrium, solubility, Solubility product and commonion effect, effect of temperature upon the solubility of precipitates, the ionic product of water, pH, effect of temperature on pH, Salt hydrolysis, hydrolysis constant, degree of hydrolysis, buffer solutions, different types of buffers and Henderson's equation.

Gravimetric Analysis:

General principles, stoichiometry, calculation of results from gravimetric data. Properties of precipitates. Nucleation and crystal growth, factors influencing completion of precipitation. Co-precipitation and post-precipitation, purification and washing of precipitates. Precipitation from homogeneous solution, a few common gravimetric determinations-chloride as silver chloride, sulphate as barium sulphate, aluminum as the oxinate and nickel as dimethyl glyoximate.

Sampling and treatment of samples for chemical analysis:

Techniques of collection of Solids, liquids and gaseous samples, dissolution of solid samples, attack with water, acids, and alkalis, fusion with Na_2CO_3 , NaOH , Na_2O_2 , $\text{K}_2\text{S}_2\text{O}_7$: Microwave assisted digestion techniques (Only elementary idea)

Volumetric Analysis:

Equivalent weights, different types of solutions, Normal solutions, Molar solutions, and molal solutions and their inter relations. Primary and secondary standard substances. principles of different type of titrations-

- i) acid-base titration, ii) redox titration, iii) complexometric titrations. Types of

indicators- i) acid-base, ii) redox iii) metal-ion indicators.

Principles in estimation of mixtures of NaHCO_3 and Na_2CO_3 (by acidimetry); Principles of estimation of iron, copper, manganese, chromium (by redox titration):

Acid base titrations: Principles of titrimetric analysis, titration curves for strong acid-strong base, weak acid-strong base and weak base-strong acid titrations, polyprotic acids, poly equivalent bases, determination of the equivalence point-theory of acid base indicators, colour change range of indicator, selection of proper indicator.

Redox Titrations: Principles behind the Iodometry, permanganometry, dichrometry, difference between iodometry and iodimetry.

Potentiometry: Fundamentals of potentiometry. Indicator and ion-selective electrodes. Membrane electrodes. Glass electrode for pH measurement, glass electrodes for cations other than protons. Liquid membrane electrodes, solid state ion selective detectors and biochemical electrodes. Applications of potentiometry. Direct potentiometric measurements-determination of pH and fluoride. Redox and potentiometric titrations- Balancing redox reactions, calculation of the equilibrium constant of the reaction, titration curves, visual end point detection. Redox indicators-theory, working and choice. Potentiometric end point detection Applications of redox titrations.

Complexometric titrations: Complex formation reactions, stability of complexes, stepwise formation constants, chelating agents, EDTA-acidic properties, complexes with metal ions, equilibrium calculations involving EDTA, conditional formation constants, derivation of EDTA titration curves, effect of other complexing agents, factors affecting the shape of titration curves-completeness of reaction, indicators for EDTA titrations-theory of common indicators, titration methods employing EDTA-direct, back and displacement titrations, indirect determinations, titration of mixtures, selectivity, masking and de-masking agents, typical applications of EDTA titrations-hardness of water, magnesium and aluminium in antacids, magnesium, manganese and zinc in a mixture, titrations involving uni-dentate ligands-titration of chloride with Hg^{2+} and cyanide with Ag^+ .

Chromatographic methods of analysis:

Basic principles and classification of chromatography. Importance of column chromatography and thin layer chromatography; Theory and principles of High Performance Liquid Chromatography (HPLC) and Gas Liquid Chromatography (GLC). Ion-exchange chromatography.

UV Visible Spectroscopy:

Basic Principles of UV-Vis spectrophotometer. Lambert -Beer's Law and its limitations. Instrumentation consisting of source, monochromator, grating and detector. Spectrophotometric determination.

Flame photometry and Atomic absorption spectrometry:

Emission spectra Vs absorption spectra. Basic Principles and theory of flame photometry. Applications of Flame photometers. Basic Principles and theory of AAS. Three different modes of AAS - Flame-AAS, VGAAS, and GFAAS. Single beam and doublebeam AAS. Function of Halo Cathode Lamp (HCL) and Electrode Discharge Lamp. Different types of detectors used in AAS. Different types of Interferences- Matrix interferences, Chemical interferences, Spectral interferences and background correction in AAS. Use of organic vents. Quantitative techniques-calibration curve procedure and the standard addition technique. Typical commercial instruments for FP and AAS. Applications. Qualitative and quantitative analysis. Relative detection abilities of atomic absorption and flame emission spectrometry.

X-ray methods of Analysis:

Introduction, theory of X-ray generation, X-ray spectroscopy, X-ray diffraction and X-ray fluorescence methods, Braggs law, instrumentation, dispersion by crystals, applications. Preparation of pellets, glass beads, quantitative and qualitative measurement.

Inductively coupled plasma spectroscopy:

Theory and Principles, plasma generation, utility of peristaltic pump, sampler — skimmer systems, ion lens, quadrupole mass analyzer, dynode /solid state Detector, different type of interferences- spectroscopic and non-spectroscopic interferences, isobaric and molecular interferences, applications.

Analysts of Minerals, Ores and Alloys:

Analysis of Minerals and Ores- estimation of (i) CaCO_3 , MgCO_3 in dolomite (ii) Fe_2O_3 , Al_2O_3 and TiO_2 in Bauxite. (iii) MnO and MnO_2 in Pyrolusite.

Analysis of Metal and Alloys: (i) Cu and Zn in Brass (ii) Cu , Zn , Fe , Mn , Al and Ni in Bronze (iii) Cr , Mn , Ni , and P in Steel (iv) Pb , Sb , Sn in type metal.

Analysis of coal and coke-Types, composition, preparation of sample, proximate and ultimate analysis calorific value by bomb Calorimetry.

Basic organic chemistry:

Inductive effect, resonance and resonance energy. Homolytic and heterolytic bond breaking, electrophiles and nucleophiles; carbocations, carbanions and radicals (stability and reactivity). Alkanes, alkenes and alkynes: Synthesis and chemical reactivity of alkanes, mechanism of free-

radical halogenation of alkanes. General methods of synthesis, electrophilic addition reactions and polymerization reaction (definition and examples only) of alkenes. General methods of synthesis, acidity, hydration and substitution reactions of alkynes.

Organometallic compounds:

Grignard reagents - preparations and reactions, application of Grignard reagents in organic synthesis. Organic compounds containing nitrogen: aromatic nitro compounds- reduction under different conditions. Methods of synthesis of aliphatic amines, Heinsberg's method of amine separation, Hofmann degradation, Gabriel's phthalimide synthesis, distinction of primary, secondary and tertiary amines; methods of synthesis of aromatic amines, basicity of aliphatic and aromatic amines. Sandmeyer reactions; synthetic applications of benzene diazonium salts.

Bonding and physical properties:

Valence bond theory: concept of hybridisation, resonance (including hyperconjugation), orbital picture bonding sp^3 , sp^2 , sp : C-C, C-N & C-O system), Inductive effect, bond polarization and bond polarizability steric effect, steric inhibition of resonance. MO theory: sketch and energy levels of MOs of i) acyclic p orbital system ii) cyclic p orbital system, iii) neutral system. Frost diagram, Huckel's rules for aromaticity & antiaromaticity; homoaromaticity. Physical properties: bond distance, bond angles, mp/bp & dipole moment in terms of structure and bonding. Heat of hydrogenation and heat of combustion.

Organic Spectroscopy:

Infrared spectroscopy: Units of frequency wave length and wave number, molecular vibrations, factors influencing vibrational frequencies, the IR spectrometer, characteristic frequencies of organic molecules and interpretation of spectra.

Ultraviolet spectroscopy: Introduction, absorption laws, measurement of the spectrum, chromophores, definitions, applications of UV spectroscopy to Conjugated dienes, trienes, unsaturated carbonyl compounds and aromatic compounds.

Nuclear Magnetic Resonance Spectroscopy: (Proton and Carbon ^{13}C NMR) The measurement of spectra, the chemical shift: the intensity of NMR signals and integration factors affecting the chemical shifts: spin-spin coupling to ^{13}C IH-IH first order coupling: some simple IH-IH splitting patterns: the magnitude of IH-IH coupling constants.

Mass spectroscopy: Basic Principles: instrumentation: the mass spectrometer, isotope abundances; the molecular ion, meta stable ions.
